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United States Department of Agriculture,

OFFICE OF EXPERIMENT STATIONS.

WASHINGTON, D. C., February 17, 1897.

RULES AND APPARATUS FOR SEED TESTING.

The testing of seeds with reference to their purity and vitality was inaugurated by Prof. F. Nobbe, of Tharand, Saxony, nearly thirty years ago. The methods which he worked out are used with more or less modification in numerous experiment stations established for seed investigation and control in Germany and other European countries. A number of the agricultural experiment stations in this country have devoted more or less attention to this line of work. The importance and value of systematic tests of seed under scientific control have been clearly demonstrated, and the necessity for the establishment of methods and regulations suited to American conditions has been more apparent as the work has developed in this country. Recently a special laboratory for seed investigations has been established in the Division of Botany of this Department. Its investigations have already greatly contributed to the working out of American standards for seed testing.

With a view to encouraging cooperation between the Department and the experiment stations in formulating methods of procedure for seed testing in different parts of the country, a memorial signed by a majority of the experiment station directors was presented to the Association of American Agricultural Colleges and Experiment Stations at the convention held in Washington in November, 1896, requesting the appointment of a "committee of experts in seed testing to devise and adopt a standard form of seed-testing apparatus and method of procedure for use in all American stations." Responding to this memorial, the association ordered the appointment of a committee to formulate rules for seed testing which might be published for the guidance of the stations during the ensuing year and reported to the association at its next annual meeting for any further action deemed advisable at that time.

The committee appointed was Dr. E. H. Jenkins, vice-director of the Connecticut Agricultural Experiment Station; Mr. G. H. Hicks, in charge of pure seed investigations of the Division of Botany of this Department; Mr. Gerald McCarthy, botanist of the North Carolina

Agricultural Experiment Station; Prof. F. W. Card, horticulturist of the Nebraska Agricultural Experiment Station, and Prof. W. R. Lazenby, professor of horticulture in Ohio State University.

The committee met at Washington, D. C., January 20, 1897, and formulated the rules for seed testing given in this circular. In this work they were aided by replies to a circular of inquiry received from officers of some 25 experiment stations which had engaged in seed investigations. While the rules thus adopted are regarded as tentative and may hereafter need more or less modification, it is nevertheless believed that they will greatly aid in systematizing seed investigations in this country and contribute to the establishment of methods by which purchasers of seeds throughout the country may be protected from fraud.

The rules for seed testing as adopted by the committee, together with the accompanying blanks for reports and a description of the approved apparatus, are submitted with the recommendation that they be published as Circular No. 34 of this Office.

Respectfully,

A. C. TRUE,
Director.

Hon. CHAS. W. DABNEY, JR.,
Assistant Secretary of Agriculture.

RULES FOR SEED TESTING.

Adopted by the committee of the Association of American Agricultural Colleges and Experiment Stations January 23, 1897.

(1) **Sending samples.**—Every sample for test should be sent to the station in a securely fastened package accompanied by a statement certifying to the fairness of the sample, its source, etc. Blanks for this purpose will be furnished by the station upon application. In case of guaranteed seed, the sample must be taken in accordance with directions given in the sampling blank No. 2.

(2) **Purity test.**—All purity tests shall be made by weight from fair, average samples of seed. The minimum quantities to be used for this determination are named below and must be so drawn as to secure a thoroughly representative sample.

One gram: Agrostis spp., the Poas, yellow oat grass, tobacco.

Two grams: Bermuda grass, velvet grass, timothy, meadow foxtail, crested dog's tail, orchard grass, sweet vernal grass, alsike clover, white clover, Umbelliferae, and all the fescues except meadow fescue.

Three grams: All grass seed not enumerated above.

Five grams: Melilotus, Medicago spp., millet, lettuce, all species of clover seed except white and alsike.

Ten grams: Cruciferæ, flax, and Lespedeza.

Thirty grams: Buckwheat, Vicia spp., Lathyrus spp., beet "balls," esparsette, lentils, sunflower, teosinte, serratella, cucurbits, and all cereals except corn.

Fifty grams: Peas, beans, corn, lupines, cotton, and cowpeas.

Amounts to be taken of seeds not enumerated shall be the same as those required for seeds named which are of similar size.

In case the sample is suspected to contain any seed of a pest, like dodder, Canada thistle, wild mustard, plantain, etc., at least 50 grams shall be examined for said impurity.

(3) *Germination tests*—(a) *Seed*.—Seed for germination tests is to be taken indiscriminately from pure seed which has been thoroughly mixed for that purpose. One hundred seeds of peas, beans, corn, cucurbits, and those of a similar size, and 200 seeds of clover, spinach, Cruciferæ, and others of similar size and smaller shall be taken for each single test.

(b) *Duplicate tests and allowable variation*.—The laboratory tests shall be made in duplicate simultaneously, under identical conditions, and the average result taken. If the duplicated tests vary more than 10 per cent, they shall be repeated; also a supplementary test should be made in sand.

(c) *Substratum to hold seeds*.—For a substratum or seed bed the committee recommends for the present year a blue blotting paper, to be obtained of Carter, Rice & Co., 246 Devonshire street, Boston, Mass.

(d) *Hard seeds*.—At the close of the blotter test one-third of the leguminous seeds which remain hard shall be counted as viable.

(e) *Supplementary tests*.—We recommend supplementary tests in sand whenever practicable in the case of the Poas, Agrostis spp., celery, tobacco, and all seeds which in laboratory tests fall 10 per cent or more below the germination standard adopted by the station.

Seeds of Agrostis, Poa, yellow oat grass, tobacco, and others of a similar size are to be sown upon the surface and the lightest possible covering of sand given them. Other seeds are to be planted at depths about equal to twice their diameter. All seeds are to be planted far enough apart to avoid contact during the process of germination.

The supplementary tests shall be made at a temperature of 20° to 30° C. (68° to 86° F.) in sand sterilized by heating, free from organic matter, and sifted to secure a uniform size. Sieves with a mesh of 1 millimeter (one-twenty-fifth inch) are recommended for this purpose.

In sand tests only those seeds shall be counted viable whose sprouts appear above the surface of the ground. The results of the supplementary tests shall be accepted when they show a higher percentage than those in blotters; otherwise the percentages secured in blotter tests only shall be used.

—The sand and blotters shall be kept well moistened, during the germination tests. Only potable water approximating that of the seed bed shall be used.

Duration of the germination tests.—The following periods of time shall be used for blotter tests: Ten full days for cereals, spurrey, peas, beans, vetches, lentils, lupines, soja beans, sunflower, buckwheat, Cruciferæ, Indian corn, and cowpeas; 14 full days for serradella, esparsette, beet "balls," rye grass, timothy, Umbelliferae, tobacco, Lespedeza,

and all other field and vegetable seeds not herein enumerated; 21 full days for grasses except Poa, Bermuda grass, rye grass, and timothy; 28 full days for Poa and Bermuda grass.

Each day the seed sprouted in blotters should be counted and removed and a careful record made of the same. Sand tests are to be continued two days longer in each case and the sprouts counted only at the close.

(h) *Temperature in germinating tests.*—It is recommended that the temperature be kept at 20° C. for eighteen hours out of each twenty-four, and in no case shall it fall below 15° C. or rise above 32° C.

For six hours out of each twenty-four the tests of all grasses (except fescues, rye grasses, and cereals) and cucurbits, cotton, eggplant, tomato, pepper, and Lima bean should be raised to 30° C. The tests of all other seeds not requiring high temperatures should be lowered to 16° to 18° C. for the same period.

(i) *Germinating chamber.*—The germinating chamber may be of any form which gives the operator proper control over the conditions of light, heat, air, and moisture. We recommend the form which is now in use in the seed laboratory of the United States Department of Agriculture, marked "Standard," and made by Ernest Betz, Washington, D. C. Said chamber is to be provided with a low-temperature thermo-regulator.

(4) *Keeping samples.*—A sufficient amount of each sample should be kept by the station in well-corked vials in a dark, dry, and cool place for six months, to be used in case a retest is found necessary.

(5) *Record.*—The report of seed tests shall include name of station, station number, name of seed, source of sample, weight of sample, date of tests, percentage by weight and character of impurities, kind of seed bed, temperature of seed bed, number of sprouts germinated each day, percentage germinated, and number of hard seeds which remain at close of test.

We recommend the form of record blank annexed, No. 1.

(6) *Report blank.*—Form No. 3 is recommended for reports of complete tests.

(7) *Time for making germination tests.*—Purchasers of guaranteed seed shall send in their samples not later than fifteen days from the date of the receipt of said seed by them. All germination tests shall be commenced within fifteen days after the seed has been received by the station.

(8) *Accessory apparatus.*—(a) A chemical balance weighing $\frac{1}{100}$ grams and sensitive to 1 milligram, kept in a case, together with metric and avoirdupois weights.

(b) A standard simple dissecting microscope and a large reading glass or pocket lens.

(c) Botanical forceps and dissecting implements.

(d) An authentic collection of the seeds of the principal weeds and economic plants.

(e) Works treating of the anatomy, morphology, and physiology of seeds, of seed growing, and seed testing; among which we recommend those of Nobbe, Harz, and Settegast.

GERMINATING CHAMBER.

The committee adopted, with a few minor changes, the germinating chamber designed by Mr. Hicks for use in the Department of Agriculture seed laboratory. It is made of 20-ounce corrugated copper and is 2 feet long, 18 inches deep, and 2 feet high, outside measurements. The outside, except the bottom, is covered with two layers of felt, each one-half inch thick.

A water space is afforded by the double walls which extend on all sides except the front and are 2 inches apart. Entrance to this water jacket is obtained at *a*, *a'* (fig. 1), while the water can be drawn off at *g*. At *c c*, on the top, and at *f*, near the bottom of one end, are 1-inch openings into the chamber. One of

the upper openings may be used for the insertion of a thermometer, if desired. Owing, however, to the influence which the external atmosphere exerts upon thermometers whose tubes are partly exposed, provision has been made for holding two thermometers in a horizontal position, one on the inside of each panel of the door to the chamber, by means of hooks of stout copper wire (fig. 2, *a a'*).

The door is made in two panels, each consisting of two plates of thick glass set about one-half inch apart in a copper frame, which is covered

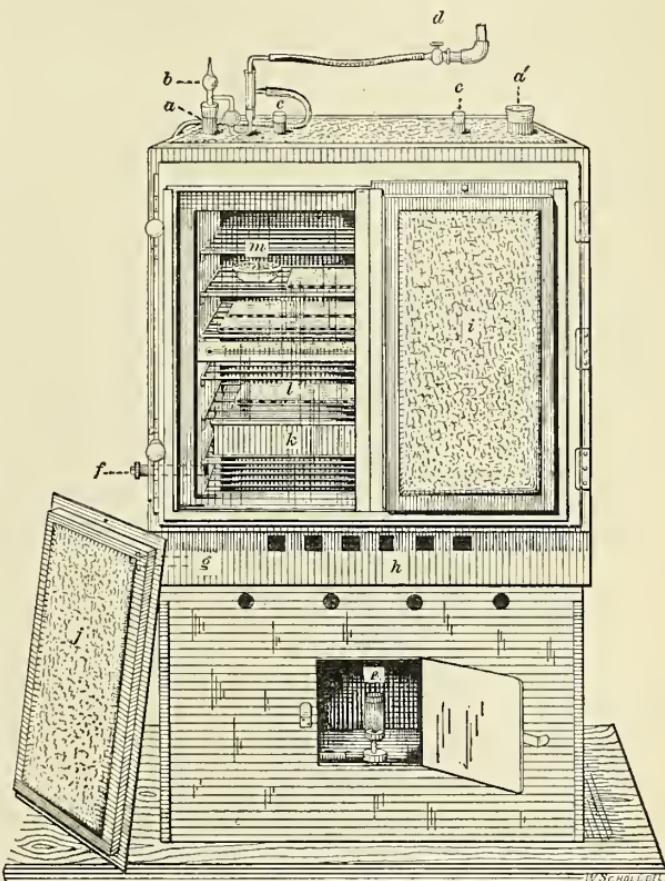


FIG. 1.—Standard seed-germinating chamber used by the United States Department of Agriculture and American Experiment Stations (front view with one door slide removed): *a*, *a'*, openings into water jacket; *b*, thermoregulator; *c*, *c'*, openings into chamber; *d*, gas entrance tube; *e*, micro-bunsen burner; *f*, gas exit; *g*, water exit; *h*, ventilator; *i, j*, door slides; *k*, pan to hold porous saucers, etc.; *l*, blotter test; *m*, porous saucers with sand test.

inside with felt. The inside margin of the door is provided with a projection (fig. 2, *c*) which fits snugly into a felt-lined groove (fig. 2, *b*), extending around the front side of the chamber. The door is 3 inches shorter than the front of the chamber, the remaining space being closed with copper and provided with a ventilator (fig. 1, *h*) which permits the exit of carbon dioxid, and can be closed tightly with a slide. Perfect closing of the door is further effected by a copper slide extending along the front margin, which catches firmly at the top and bottom of the chamber (fig. 2, *d d*). This device, together with the groove and its corresponding projection, are adapted from the Rohrbeck bacteriological chamber. The outside door is furnished with a frame into which slide two plates of galvanized iron painted dead black inside and covered with felt (fig. 1, *i j*). By this arrangement the interior of the chamber may be kept dark or exposed to light, or, if desired, one-half may be dark and the rest light, the other conditions remaining the same. By

raising these slides the thermometers can be read without opening the door. Glass plates of various colors may be substituted for the slides if the effects of different rays of light on plant growth are to be studied.

Seven movable shelves, placed $2\frac{1}{4}$ inches apart, are held in place by copper ledges one-quarter inch wide. These shelves are made of galvanized iron rods $1\frac{1}{2}$ inches apart, and each one is capable of holding up 60 pounds weight.

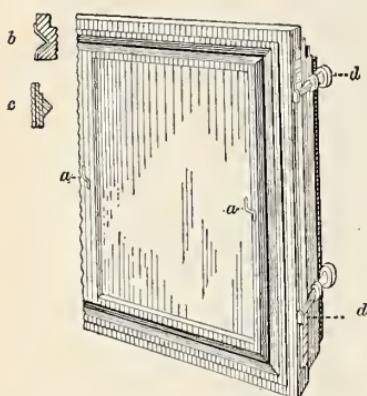
The temperature is controlled by a low-temperature thermoregulator (fig. 1, *b*). A very low and equable flame is secured with a micro-bunsen burner (fig. 1, *e*). One of the openings into the

FIG. 2.—One-half of door (inside view): *a a*, hooks for holding thermometer; *b*, section of groove in chamber into which fits *c*, projection on door; *d d*, door fastener.

water jacket (fig. 1, *d*) is 2 inches in diameter to admit a Roux thermoregulator, if a very even temperature is desired, as in bacteriological work. Fresh air or different gases can be forced into the chamber at one of the openings at the top (fig. 1, *c c*) and out at the bottom (fig. 1, *f*). Each of the openings at the end (fig. 1, *f g*) is closed with a screw cap.

The chamber is provided with three tin-lined copper pans, each having a narrow ledge around the inside near the top, which serve to hold copper rods with folds of cloth, if the experimenter wishes to test seeds according to the Geneva pan method. The pans also serve to hold porous saucers or plates.

The chamber when empty weighs about 100 pounds, and is therefore easily moved. The shelves will hold about sixty blotter tests, with an equal number of duplicates. It rests upon a detachable base consisting of a stout iron frame 15 inches high, inclosed with a sheet-iron jacket.



This germinating chamber is made by Ernest Betz, Washington, D. C., for \$72, without the regulator or burner, but has not been patented. As will be seen by the above description, it will answer perfectly in the study of bacteriology, plant physiology, or seed testing.

BLANKS FOR RECORD, SAMPLING, AND REPORT.

(Form No. 1.)

Seed-test register of the Agricultural Experiment Station.

Station No. Scientific name of seed Common name

			A	B.
			Blotting paper.	Sand.
			1	2
Sent by		Date of germinating test.....		
Name under which received.....		Number of seeds.....		
Date received		Range of temperature (Centigrade).		
Date reported		(1)		
Date of purity test.....		(2)		
Where grown		(3)		
Claimed age of seed.....		(4)		
Price asked for seeds.....		(5)		
Weight of smaller average sample (grams)		(6)		
Per cent of impurities by weight.....		(7)		
	Inert matter:	Foreign seeds:	Total:	
Per cent of purity.....				
Standard of purity.....				
Character of inert matter				
	Name.	No.	Duration of experiment in days.	
Foreign seeds	Useful		No. of full days elapsed before $\frac{1}{2}$ sample had germinated	
	Noxious		No. of seeds remaining hard at close of test	
			Percent germinated	
			Average per cent germinated	
			Standard of germination	
		P \times V		
		100	Guaranty: purity	viability
			Guarantor:	

REMARKS:

Conductor of Purity Test.

Conductor of Germination Test.

(Form No. 2.)

Blank for describing seed samples.

(This form must be filled out completely or the sample may be rejected.)

(Do not write here.)

....., 189...

{ Station No.

To the Director of the

{ Received

Agricultural Experiment Station,

SIR: I send you to-day, marked, contained in a, a fair sample of seed, drawn according to directions on the other side of this sheet.

Kind of seed

Sold by

At city or town of

Grown by, in County, State of

(Sender of sample must give following particulars:)

1. Name under which seed is sold

2. The year in which the seeds were said to have been grown

3. The price at which it was offered for sale

Name of sender

Post-office

County

State

* Witness: I hereby certify that the above-described sample was taken in my presence, according to the rules on the back of this sheet.

Name

Address

* To be used when guaranteed seed is sent for test.

(Reverse of sampling sheet, form No. 2.)

NOTE.—This station assumes no responsibility for the accuracy of samples not drawn by one of its agents.

DIRECTIONS FOR SAMPLING SEEDS.

1. The contents of packets should be emptied out, mixed thoroughly by stirring, and small quantities taken from different parts of the mixture to make the sample which is sent to the station.

If seeds are in bulk or in large packages, take handfuls at random from the top, middle, and bottom, and from these, after mixing, take the sample for testing.

2. Samples of seeds sold under specific guarantee of quality must be taken in the presence of a disinterested and reputable witness, who shall sign the certificate on the other side of this sheet. The sample must be inclosed in an envelope or other suitable package, securely fastened and sealed with wax in the presence of the witness. The names of the sender and witness must be written on the outside of package, which shall be sent to the station prepaid.

3. Samples shall weigh approximately as follows:

Grasses, except noted below, 1 ounce.

Clovers and all seeds of similar size, 2 ounces.

Cereals, vetches, beet "balls," and all larger seeds, 4 ounces.

Rye grasses, bromes, sorghums, and millets, 2 ounces.

All the smaller vegetable seeds, 1 ounce.

All the larger vegetable seeds except beet "balls," 2 ounces.

NOTE.—A complete report on the sample can usually be made within two weeks in the case of cereals and most vegetables and leguminous seeds, and within three weeks for most grasses. The purity of a sample can usually be determined within a few days.

As samples of mixed seeds are difficult to separate and determine, and the results do not justify the time and labor involved, the station will as a rule refuse such samples.

(Form No. 3.)

Seed report blank.

THE AGRICULTURAL EXPERIMENT STATION,
..... DIRECTOR,
..... 189...

Station No.

SIR: The sample sent to this station in a, marked, was received

It contains per cent by weight of seed of, common name, and per cent of impurities.

The impurities consist of: Inert matter, per cent; foreign seeds, per cent, of which per cent are noxious.

Of 100 seeds of, seeds proved capable of germination, and one-half of these germinated in days.

There are in one hundred parts by weight of the sample parts of pure seed capable of germination.

Choice merchantable seed of this species should have a purity of per cent; viability of per cent, and should be free from

REMARKS

Yours, truly,

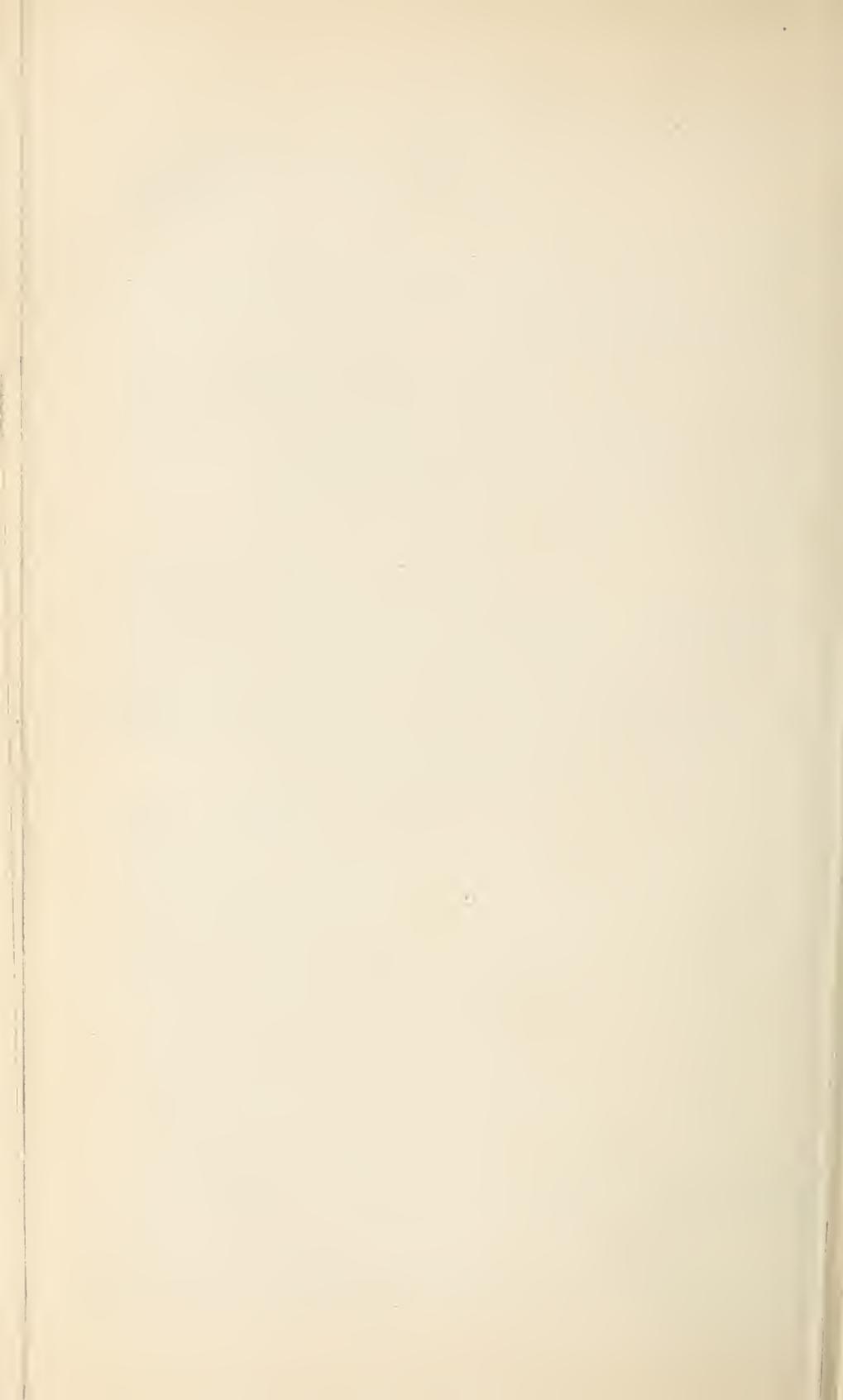
..... *Director.*

The above report was unanimously adopted by the committee and is recommended for trial at the stations where seed tests are made. It is earnestly hoped that the rules here proposed will be thoroughly tested at a number of the stations and that the results will be promptly reported. It is especially desirable that suggestions for changes in the rules should be called to the attention of the committee prior to the next meeting of the Association of Colleges and Stations.

E. H. JENKINS,
G. H. HICKS,
GERALD McCARTHY,
F. W. CARD,
W. R. LAZENBY,

Committee.





U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—CIRCULAR NO. 34 (Revised).

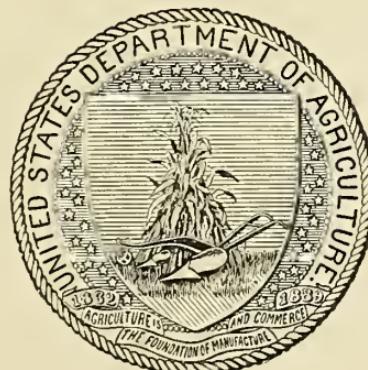
A. C. TRUE, Director.

RULES AND APPARATUS

FOR

SEED TESTING.

[Adopted by the Standing Committee on Methods of Seed Testing
of the Association of American Agricultural Col-
leges and Experiment Stations.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1904.



SEMPERS GERMINATING CHAMBER.

[Supplementing U. S. Department of Agriculture, Office of Experiment Stations Circ. 34 (revised).]

This germinating chamber is modeled after one designed and used by Mr. Frank W. Sempers, of Blythedale, Md. While the temperature can not be kept as uniform in this as in the standard chamber, it gives excellent results for regular work. On account of its simple construction it can be made at a low cost by any good carpenter with the aid of a tinsmith. Fig. 11 (of the circular referred to above) shows working drawings of this chamber.

It is essentially a tight, wooden box, with doors on the front, ledges on the sides and in the middle to carry the trays, and an open water tank let through the bottom. This differs from other forms of germinating chambers in that the heat is applied directly underneath the water tank, which opens into the chamber. The water vapor furnishes the necessary heat and keeps the germinating seeds and substratum moist. A small space (h) is left between the two tiers of trays in which a thermometer and thermostat can be inserted. The water tank (d) is copper with a 1-inch flange (f) around the top by which it is fastened to the bottom of the chamber. The sides of the tank extend $2\frac{1}{2}$ inches below the bottom (e) to partially confine the heat from the lamp or gas burner underneath. The doors shut against wide cleats all around so that shrinking and swelling will not prevent their opening and shutting easily.

